THE BEALIBA METEORITE FROM VICTORIA

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The Bealiba Meteorite is an L6 chondrite discovered in the collections of the Geological Survey of Victoria. The single 652 gram specimen was donated to the Geological Survey in 1950 by J. E. Renshaw but was not recognised as a meteorite. The collecting site was given as "one mile north of Bealiba", Victoria. The meteorite consists of poorly defined chondrules and irregular metallic grains in a recrystallised matrix. The main minerals present are orthopyroxene, olivine, oligoclase, troilite, kamacite, taenite, diopside and chromite. Microprobe analyses of these minerals are typical of L6 chondrites. Goethite alteration occurs around the Fe–Ni grains and in veinlets in the groundmass. The Bealiba Meteorite is the second L6 chondrite discovered in Victoria.

THE BEALIBA meteorite is a previously unrecorded L6 chondrite, with a fall site near the small central Victorian town of Bealiba (36°48′ S, 143°33′ E), about 30 km northwest of Maryborough (Fig. 1). The specimen was discovered during early 1989 in the collections of the Geological Survey of Victoria (GSV), following their transfer to the Museum of Victoria in 1987. The author recognised the meteorite while sorting a tray of miscellaneous rocks. It was registered in the GSV collection as no. 11635 and labelled as "ironstone with sandstone", from 1 mile north of Bealiba, Victoria. It had been donated to the GSV by Mr J. Renshaw in October 1950. The Bealiba meteorite is now registered as no. E12275 in the collection of the Department of Mineralogy and Petrology, Museum of Victoria. The name, together with data for classification, were approved by the Nomenclature Committee of the Meteoritical Society early in 1990.

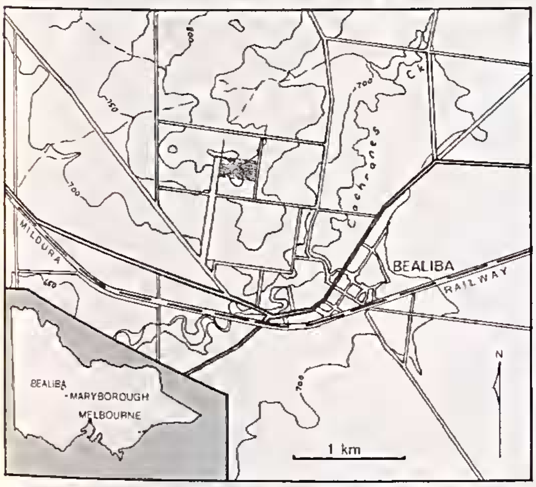

Fig. 1. Locality map showing the likely discovery and fall site of the Bealiba Meteorite, the former Renshaw paddock (stippled block), 1.6 km northwest of Bealiba, Victoria.

HISTORY OF DISCOVERY

In order to verify the original fall site, attempts were made to contact surviving members of the Renshaw family. Two sisters, Alva and Mary Renshaw, of Newstead, Victoria, confirmed that their late brother, Joseph E. Renshaw (1907–1977), was an avid collector of geological specimens and spent considerable time fossicking in bushland around Bealiba. He also paid regular visits to the GSV Museum in Melbourne. The father of the family, Joseph A. Renshaw, ran a drapery in Bealiba and owned a 10-acre "paddock" north of the town. This block is presumed to be the original fall and discovery site (Fig. 1).

A visit to the block (Fig. 2), about 1.6 km northwest of Bealiba, showed it to be situated on the southern slopes of a small hill. The country is now lightly wooded but was probably largely clear of trees in 1950. The block has recently been sold as part of a rural residential development.

GEOLOGY OF THE SITE

Weathered yellowish Lower Ordovician marine siltstones and shales, with a north–south strike, outcrop on the block. Some fragments of white reef quartz are also present. In such an area, a meteorite would look out of place to a keen geological observer.

Fig. 2. The present-day appearance of the Renshaw paddock, in foreground, looking southeast towards Mt Bealiba.

FEATURES OF THE METEORITE

The meteorite is roughly equidimensional and measures 90 by 80 by 55 mm. Its thin, dark brown fusion crust is nearly complete, apart from where a small portion had been broken off one end, possibly on impact (Fig. 3A). The exposed area, roughly 75 by 50 mm, has the texture of weathered buff-coloured sandstone, with scattered patches of dark brown iron oxide staining several millimetres across. The specimen had a mass of 652 g and a density of 3.9 g/cc prior to removal of a slice for thin sectioning. A glassy tumulose patch, 20 mm across, occurs on one surface (Fig. 3B). This feature is not associated with any internal textural variation and may have been caused by the application of a high

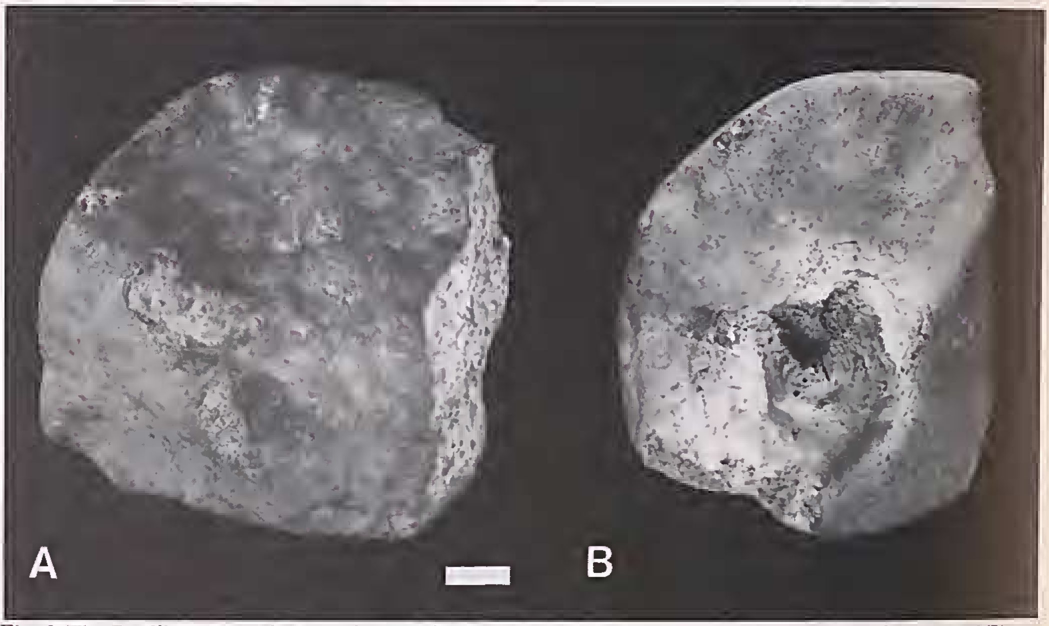

Fig. 3. The Bealiba Meteorite showing (A) fusion crust with missing portion removed on impact, and (B) tumulose patch caused by artificial heat source. Scale bar is 10 mm.

temperature heat source, such as an oxy-acetylene flame, by the finder.

PETROGRAPHY AND MINERALOGY

In thin section, the Bealiba meteorite shows plentiful but mostly poorly defined chondrules up to 2.5 mm across, together with irregular metallic grains up to 2.5 mm across, in an extensively recrystallised granular matrix which has been heavily stained with iron oxides. The main groundmass minerals are olivine, with less abundant orthopyroxene and interstitial oligoclase. Glass is absent. The chondrules may be fine-grained or barred olivine or orthopyroxene types, with minor clinopyroxene and interstitial sodian feldspar. Others consist of a distinct annulus of olivine and a core of rounded olivine grains in optical continuity (Fig. 4).

Fig. 4. Olivine chondrule 1 mm in diameter, showing distinct annular rim and etched core in optical continuity.

Microprobe analysis (Table 1) showed the olivine in both the groundmass and chondrules to be quite uniform in composition. Six analyses gave an average formula of $Fo_{74.6}Fa_{24.9}Te_{0.5}$ (mol%). The orthopyroxene is Mg-rich ("bronzite") with an average composition expressed by $En_{77}Fs_{21.5}Wo_{1.5}$ (average of 5 analyses), and the uncommon clinopyroxene is diopside (Fig. 5). The interstitial oligoclase is $Ab_{83}An_{11}Or_{6}$.

The main metallic minerals in the meteorite are kamacite, troilite and taenite, which together constitute about 5% of the stone. Kamacite occurs as irregular grains up to 2 mm across, showing as creamish white and highly reflective in incident light. Taenite is not as common and generally forms smaller grains, although some of the larger grains show the two minerals in sharp contact. The taenite may be distinguished by its slightly greyer colour, but unless the two minerals are in contact they cannot easily be distinguished optically. Troilite is as common as kamacite and forms irregular pale brownish

	1	2	3	4	5
SiO_2	37.76	64.78	55.40	54.07	—
TiO_2	0.02	—	0.26	0.55	3.31
Al_2O_3	—	19.78	0.15	0.46	6.21
Fe_2O_3	—	1.83	0.56	—	—
Cr_2O_3	—	—	0.13	0.64	54.50
NiO	—	—	0.06	0.08	—
FeO	23.10	—	14.54	5.25	31.65
MnO	0.41	—	0.38	0.23	—
MgO	38.21	0.87	28.14	16.19	2.27
CaO	—	2.16	1.01	22.07	—
Na_2O	—	9.70	—	0.60	—
K_2O	—	1.12	—	—	—
Total	99.50	100.24	100.53	100.14	97.94

1. Olivine (chondrule rim) $Fo_{74.4}Fa_{25.2}Te_{0.4}$
2. Oligoclase (groundmass) $Ab_{83.4}An_{10.3}Or_{6.3}$
3. Orthopyroxene (g'mass) $En_{75.5}Fs_{22.5}Wo_{2.0}$
4. Diopside (in chondrule) $En_{46.1}Wo_{45.2}Fs_{8.7}$
5. Chromite (groundmass)

Table 1. Microprobe analyses of non-metallic minerals in the Bealiba Meteorite. Analyses obtained using Cameca and Jeol microprobes at 15 kV and specimen current 0.02 μA. Standards included corundum (Al), wollastonite (Ca, Si), pure metals (Cr, Ni, Mn), hematite (Fe), jadeite (Na), rutile (Ti) and synthetic KTa (K). Fe partitioned by stoichiometry.

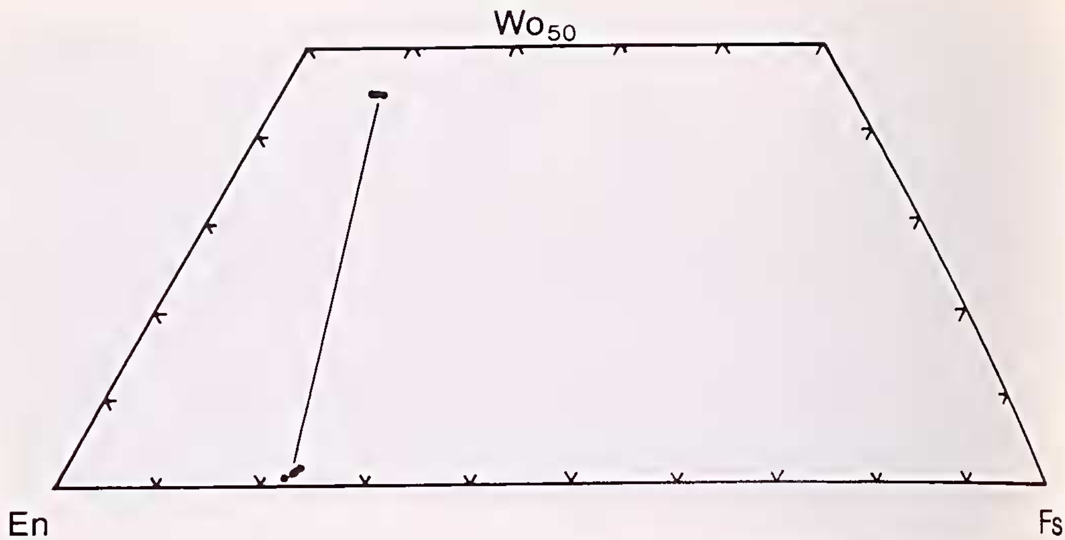

Fig. 5. Pyroxene quadrilateral showing compositions of the orthopyroxene and clinopyroxene in the Bealiba Meteorite.

pink grains up to 2.5 mm. Chromite is widespread as rounded pale grey grains up to about 0.1 mm across. Thin concretionary rims to kamacite grains consist of goethite, which also occurs as small skeletal grains and microveinlets in the groundmass. These features are a result of breakdown of the metallic minerals during weathering.

Microprobe analysis of various grains of kamacite and taenite showed compositional ranges represented by Fe/Ni = 14–17 and Fe/Ni = 1.9–2.7 (wt% basis) respectively. Cr contents were below detectable limits. The chromite contains small amounts of Al, Ti and Mg (Table 1). Chlorine-bearing areas associated with the Fe-rich alteration around kamacite grains suggest the presence of akaganéite (Buchwald & Clarke 1989).

CLASSIFICATION

A full chemical analysis of the Bealiba meteorite was not carried out but the meteorite can be classified on textural and mineralogical grounds. Summarising the criteria for chondrite classification based on Dodd (1981) and Van Schmus & Wood (1967), the Bealiba meteorite has: homogeneous olivine ($Fo_{75}Fa_{25}$) and pyroxene compositions; an orthorhombic low-Ca pyroxene; feldspar forming distinct groundmass and interstitial grains, and with composition $Ab_{83}An_{11}Or_{6}$; chondrules ranging from distinct to poorly defined; a matrix which is relatively coarse-grained and recrystallised; and distinct kamacite and taenite grains. On these grounds, the Bealiba meteorite is best classified as an L6 chondrite.

CONCLUSION

Meteorite discoveries are uncommon in Victoria, although ironically the fall of the rare carbonaceous chondrite at Murchison in September 1969 is one of the best-documented and most spectacular of all known meteoritic events. Bealiba is only the tenth Victorian meteorite described (Henry 1988, Fitzgerald 1980) and the second L6 chondrite. The first L6 chrondrite, the Kulnine Meteorite, is a single stone of 55 kg collected on Kulnine Station west of Mildura around 1886 (Walcott 1916). It has some unusual chemical and textural features suggestive of higher than usual crystallisation temperatures and possible "shock" recrystallisation (Mason 1973). Based on the 300 km separation of their discovery sites and their different features, the Bealiba and Kulnine meteorites represent distinct fall events.

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